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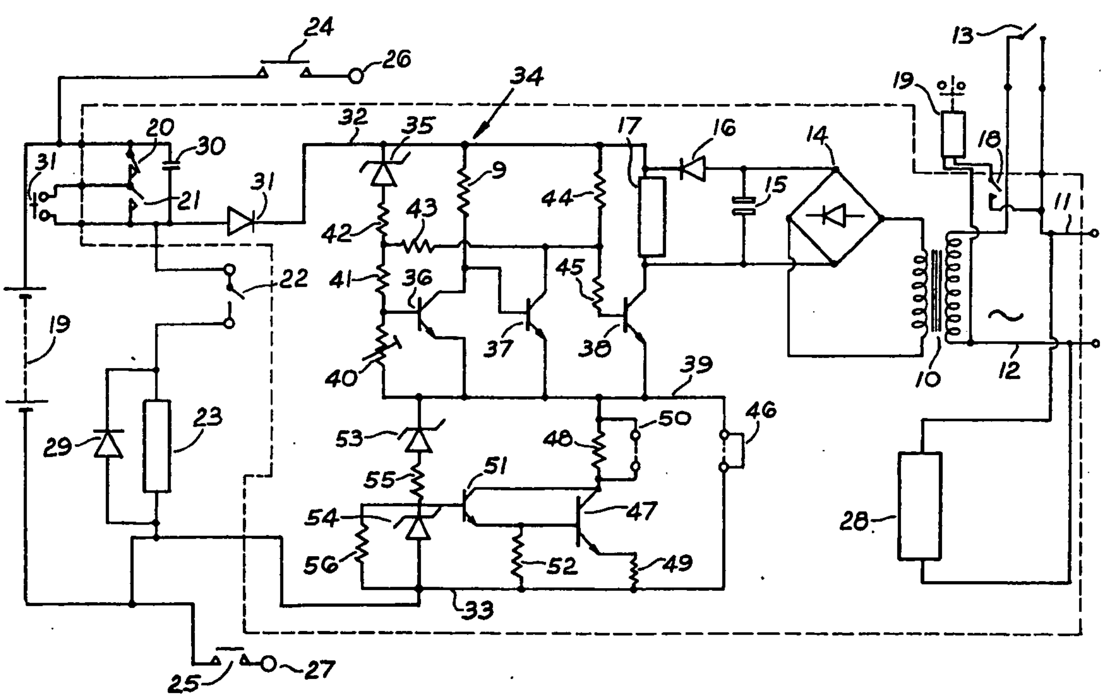
(71) Applicants
J. Smith (Brinksway) Limited, Manor Lane, Holmes Chapel, Crewe, Cheshire
(72) Inventors
Trevor Charles Boxer
David John Smith
(74) Agents
Barlow, Gillett & Percival

(54) **Emergency standby power control system**

(57) An emergency power control system for interconnecting a mains supply (11, 12) and an emergency supply such as a battery (19) and for connecting the emergency power supply to a load upon failure of the main supply (11, 12) has voltage sensitive means (34) for disconnecting the emergency power supply (19) from the load when its voltage falls below a predetermined value to prevent damage to or excessive draining of the emergency power supply (19).



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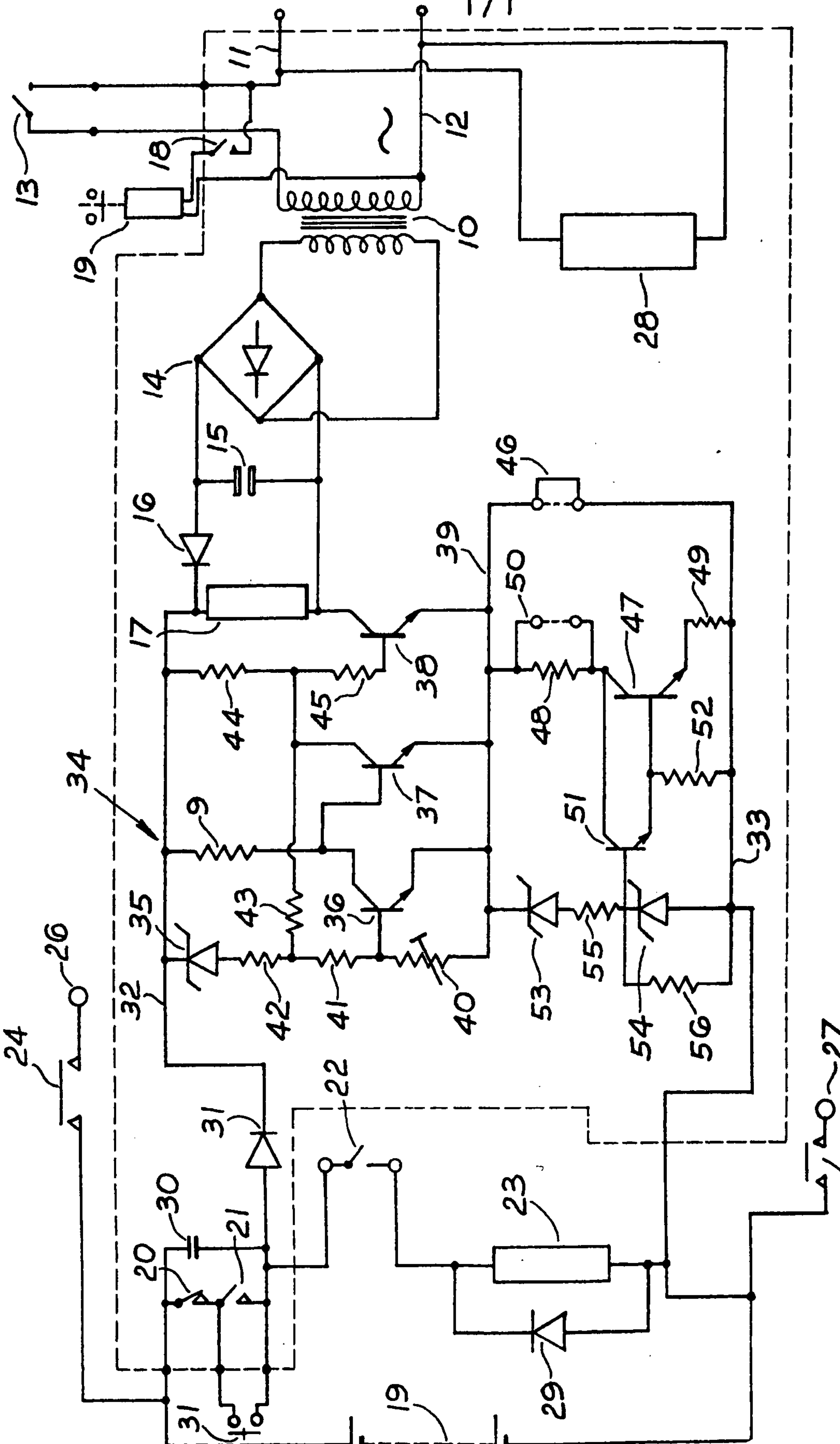

SPECIFICATION

Emergency power control system

The invention converns a system for automatically connecting a load to an emergency source of electrical power in the event of failure of a main electrical power supply.

A disadvantage of known systems of this type is that, when the emergency source of power comprises a battery unit, the batteries (or accumulators) may be damaged by deep discharge in the event of a prolonged main power failure.

A further disadvantage of known systems is that the battery may be discharged by a mains failure at a time when emergency lighting is not required because either the building is not occupied or there is adequate natural lighting.

It is an aim of the present invention to overcome at least the first of the above referred to disadvantages.

According to the present invention there is provided an emergency power control system comprising means for automatically connecting an electrical load to an emergency battery power supply in the event of failure of a main power supply, characterised in that the apparatus further comprises means for automatically disconnecting the load from the emergency power supply in the event that the emergency supply voltage falls below a predetermined value.

In order to prevent hunting of the system it is highly desirable for the means for automatically disconnecting the load from the emergency supply to be adapted to maintain said disconnection even on restoration of the emergency supply voltage to a value above the predetermined value.

To overcome the above referred to further disadvantage of known systems means may be provided for ensuring that the means for connecting the load to the emergency supply is operative only when emergency power is required.

Thus means may be provided whereby the control system is activated or put in a state of preparation automatically when a main power outlet is switched on. Means may be provided for manually overriding the system to connect the load to the emergency power supply in the event of a power supply failure occurring when the control system was not activated or in a state of preparation.

The present invention will hereinafter be further described by way of example with reference to the accompanying drawing which is a circuit diagram of a power control system, constructed in accordance with the present invention.

In the diagram a transformer 10 is supplied with an alternating mains voltage through lines 11 and 12, an external switch 13 being disposed in line 11. The output of transformer 10 is connected to a diode bridge rectifier 14 and the full wave rectified voltage from the rectifier 14 is taken by way of a capacitor 15 and diode 16 to a relay coil 17 controlling a switch 18 disposed in a first of two lines connecting a contactor 19 respectively between line 11 and 12. It should be mentioned here that line 11 is the "live" line whilst line 12 is "neutral" so that both switches 13 and 18 are connected in live lines. The connector 19 acts as a general lighting control, for example, by connecting a lighting fuse board to separate mains feed. In normal circumstances, therefore, actuation of switch 13 activates coil 17 thereby closing switch 18 to provide for general lighting.

A battery unit 19 is connected through switches 20, 21 and 22 to a contactor coil 23 operative to close switches 24 and 25 thereby connecting output terminals 26 and 27 to the battery unit 19. A load, such as an emergency lighting circuit, is connected between terminals 26 and 27. Switch 21, like switch 18, is actuated by relay coil 17, and also like switch 18 of the "normally open" type so as to be closed when coil 17 is actuated but otherwise open. Switch 20 however, is of the "normally closed" type and is controlled by a relay coil 28 connected across mains input lines 11 and 12. Switch 20 is open when coil 28 is activated but closes in the event of a mains supply failure. A diode 29 is connected across coil 23 to protect the coil during switching, whilst a capacitor 30 connected in parallel with relay contact switches 20 and 21 serves to prevent sparking across the switch contacts. A push button override switch 31 is connected in parallel with switch 21. The coil 23 is connected on one side through switch 22 and a diode 31 to a line 32, and on the other side directly to a line 33. Between lines 32 and 33 is connected a voltage sensing circuit (indicated generally by the numeral 34) which in the event of power failure constantly monitors the battery unit output voltage and activates coil 17 provided the battery voltage is above a predetermined value.

The voltage sensing circuit 34 comprises a zener diode 35 and transistors 36, 37 and 38 connected between line 32 and a line 39. Transistor 36 is an NPN type whose emitter is connected directly to line 39 and whose collector is connected through a resistor 9 to line 32. The base of transistor 36 is connected through a variable resistor 40 to line 39 and through resistors 41 and 42 to the diode 35. A resistor 43 is connected between the mid-point of resistors 41 and 42 and the mid-point between resistors 44 and 45 connected between the base of transistor 38, and line 32. The collector of transistor 36 is also connected to the base of transistor 37 whose collector is connected between resistors 44 and 45. Line 39 is connected by way of a removable link 46 directly to line 33. A transistor 47 with collector resistor 48 and emitter resistor 49 is connected between lines 39 and 43 and a removable link 50 is disposed in parallel with resistor 48. The emitter of a transistor 51 is connected to the base of transistor 47 and the collectors of transistors 51 and 47 are connected together. A resistor 52 is connected between the emitter of transistor 51 and line 33. The base of transistor 51 is connected between the zener diodes 53 and 54, a resistor 55 being disposed between the diodes 53 and 54, and a resistor 56 being connected in parallel with

diode 54.

The operation of the power control system will now be described. Initially switch 13 will be closed by the user of the system who requires the general lighting to be activated. When switch 13 is thus closed alternating voltages is applied to the input (primary) of transformer 10, and transformed alternating voltage is taken from the output (secondary) of the transformer to rectifier 14 which in turn supplies rectified voltage to relay coil 17, capacitor 15 serving to smooth the rectifier output. Relay coil 17, thus activated, closes switch 18 so that contactor 19 actuates the general lighting coil. At the same time switch 21 is closed, switch 20 being maintained in an open state, it will be understood, by relay coil 28 activated by the mains supply to lines 11 and 12.

In the event of mains failure, relay coil 28 is deactivated and switch 20, no longer held open, returns to the closed position. Switch 21 however, is not immediately opened because capacitor 15 discharges through relay coil 17 and maintains coil 17 activated despite there being no voltage output from diode bridge 14. Thus, for a short period both switches 20 and 21 are closed so that provided switch 22 is closed, (this switch being actuated by, for example, a door) contactor 23 is actuated, switches 24 and 25 are closed and the battery unit 19 is connected to output terminals 26 and 27.

The voltage sensing circuit 34 serves to maintain coil 17 activated during the mains failure since current flows through zener diode 35 to the base of transistor 36 which conducts, therefore holding transistor 37 off which in turn allows transistor 38 to conduct so that current supplied by the battery unit flows through coil 17 to line 39 and, by way of link 46 and line 33, is returned to the battery unit. Should the battery unit voltage fall below a value determined by the breakdown voltage of the diode 35 and resistors 42, 41 and 40 then diode 35 will cease to conduct, the voltage at the base of transistor 40 will fall to an extent sufficient to switch off transistors 36 consequently switching on transistor 37 to switch transistor 38 off and thereby discontinue the flow of current through coil 17. As a result, switch 21 opens, coil 23 is deactivated and switches 24 and 25 are opened to disconnect the battery unit 19 from the load. The battery voltage at which diode 35 ceases to conduct may be varied by adjusting the variable resistor 40. For a lead-acid battery unit the voltage at which disconnection is required is typically 1.7 V per cell whilst for a nickel-cadmium unit, the voltage is typically 1.0V per cell and in both cases disconnection is required at about 20V for a nominal 24V unit.

It will be seen that link 46 provides a short circuit between lines 33 and 39 so that when in place the other circuit components disposed between the two lines are ineffective. In the present example, link 46 is in place when the battery unit 19 supplies 24V and is removed if the battery unit supplies 48V. Both links 46 and 48 are removed to suit a battery unit supply voltage of 110V and diode 53 is chosen in accordance with the battery unit voltage. Assuming the battery unit voltage is 48V and that the parameters of diode 53 are chosen in accordance with the corresponding predetermined minimum voltage. Link 46 will be removed and when the predetermined battery voltage is reached diode 53 ceases to conduct and so also does diode 54 (previously serving to maintain a fixed base voltage at transistor 51) and current ceases to flow between line 33 and 39 and consequently no current flows through coil 17 which is thus deactivated. As previously described, when coil 17 is deactivated switch 21 opens so that the supply to coil 23 is discontinued, switches 24 and 25 are opened, and the emergency supply is interrupted. With switch 21 open, the supply to sensing circuit 34 is also interrupted so that there is no possibility of coil 17 being reactivated when the battery unit voltage recovers. The circuit cannot be re-set until the mains supply is restored. For operation with a battery unit voltage of 110V diode 53 is chosen accordingly and link 50 is removed as well as link 46. Removal of link 50 makes collector resistor 48 effective so that the voltage across transistors 51 and 47 is adjusted in operation to allow for the different battery unit supply voltage. All the components between lines 33 and 39, other than zener diode 53 thus remain the same and adjustment to suit different battery unit voltages is effected by inserting or removing links 50 and 46 and choosing diode 53 accordingly.

When the mains supply is restored the relay coil 28 is activated. Consequently switch 20 is opened so that the supply to coil 23 is interrupted and switches 24 and 25 are opened. At the same time relay coil 17 is activated to close switch 18 thereby activating coil 19 and the general lighting circuit. Switch 21 is kept closed by coil 17.

Should a mains failure occur when switch 13 is open the closing switch 13 will not bring the emergency power source into operation because coil 17 will be deactivated and capacitor 15 will be discharged. To overcome this difficulty the push-button override switch 31 may be closed thereby connecting sensing circuit 34 with the battery unit 19, and thus activating coil 17. It will be noted that the general lighting contactor coil 19 is only activated when coil 17 is activated so that general lighting is only obtained when the emergency power control system is in a state of readiness.

Switch 13 may, instead of being manual, be an automatic time-controlled or photo-sensitive switch. Switch 22 may be a door-interlock switch or similar device enabling disconnection of the battery unit 19, for safety purposes. This is particularly necessary when dealing with battery unit voltages of 110V DC and over or where an inverter is used to provide a higher voltage from the battery unit. The contactor comprising coil 23 and switches 24 and 25 may, in a modified system, be replaced by a change-over contactor or switching a load between the output terminals of a mains transformer (or similar power source) and the output terminals of the emergency power source.

CLAIMS

1. An emergency power control system comprising means for automatically connecting an electrical load to an emergency battery power supply in the event of failure of a main power supply, characterised in that the apparatus further comprises means

for automatically disconnecting the load from the emergency power supply in the event that the emergency supply voltage falls below a predetermined value.

2. A system as claimed in claim 1, wherein the means for automatically disconnecting the load from the emergency supply is adapted to maintain the disconnection even on restoration of the emergency supply voltage to a value above the predetermined voltage.

3. A system as claimed in claim 1 or 2, wherein means is provided for ensuring that the means for connecting the load to the emergency supply is operative only when emergency power is required.

4. A system as claimed in claim 1, 2 or 3, wherein means is provided for manually overriding the system to connect the load to the emergency power supply in the event of a power supply failure occurring when the control system was not activated or in a state of preparation.

5. A system as claimed in any preceding claim wherein the means for automatically disconnecting the load from the emergency power supply in the event that the emergency supply voltage falls below a predetermined value includes voltage-sensitive circuitry connected to the emergency supply and being variable to enable the predetermined value to be varied to suit emergency power supplies of different nominal voltages.

6. An emergency power control system substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

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